

**State of Wisconsin/Department of Transportation**  
**RESEARCH PROGRESS REPORT FOR THE QUARTER ENDING: Mar 31, 2002**

Program: SPR-0010(36) FFY99		Part: II Research and Development	
Project Title: Effect of Pavement Thickness on Superpave Mix Permeability and Density		Project ID: 0092-02-14c	
Administrative Contact: Nina McLawhorn		Sponsor:	
WisDOT Technical Contact: Error! Bookmark not defined.		Approved Starting Date: Nov 7, 2001	
Approved by COR/Steering Committee: \$225,321.00		Approved Ending Date: Nov 7, 2004	
Project Investigator (agency & contact): Jeff Russell: UW-Madison			

**Description: Error! Bookmark not defined.**

<b>Total study budget</b>	<b>Current FFY budget</b>	<b>Expenditures for current quarter</b>	<b>Total Expenditures to date</b>
<b>\$225,321.00</b>	<b>\$56,330.25</b>	<b>\$0.00</b>	<b>\$0.00</b>

**Progress This Quarter:**

(Includes project committee mtgs, work plan status, contract status, significant progress, etc.)

The work that has been accomplished during the last quarter can be separated into three different parts as follows:

**1. Literature Review**

The literature review conducted regarding reports on the permeability of asphalt mixtures was completed and summarized in a concise report. The collected information was divided into four main categories including fundamental concepts (equipment, method and measurement), laboratory studies, field studies, and imaging techniques.

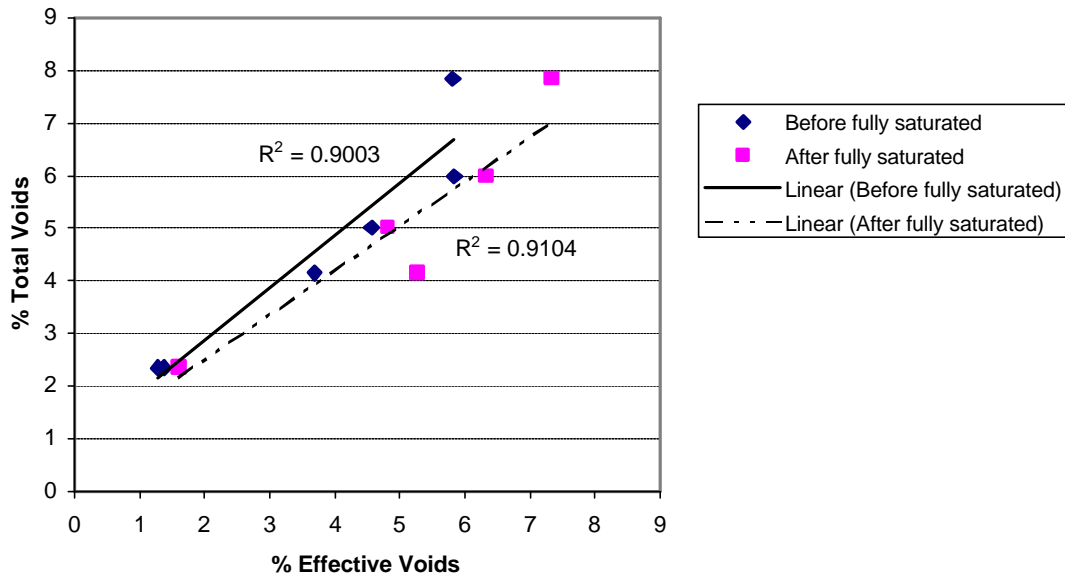
In the fundamental concept category, the literature review indicates that there are a number of devices and methods that are used for measuring the permeability in the laboratory and the field. In other categories, it can be observed that many mixture variables can affect permeability and that there are critical range values defined by various researchers to control permeability. Although the literature review will continue the next quarters, the interim findings from the literature are summarized in the attachment to this report (See attached document-Part 1).

Based on the literature review, the most appropriate equipment and method will be selected for this project. In addition the critical variables that have major effects on permeability will be identified and focused on in this study. Although an initial selection of methods and variables related to permeability has been made, further study is planned to collect additional information before a final list will be defined.

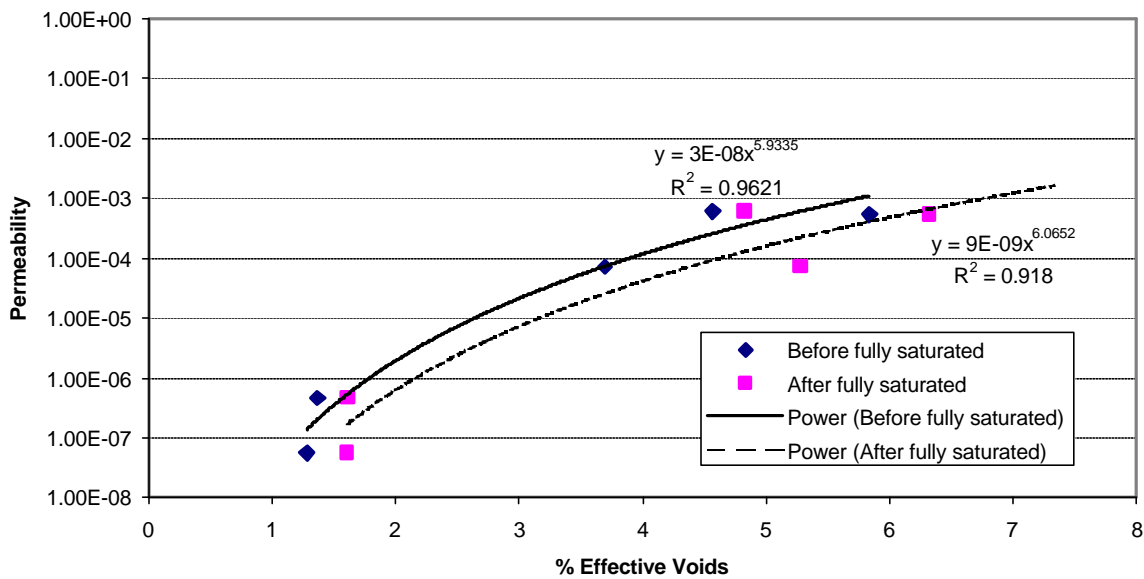
**2. Effective Voids Study**

As indicated in the literature, a question was raised regarding to the relationship between the percent of total voids and the permeability. A group of researchers have stated that using the total voids is not sufficient to predict the permeability. Since the interconnectivity of voids has been found to play a significant role, the percent of effective air voids, which is the percent of water permeable voids, should be considered in studying permeability.

In this quarter, the researchers have performed the test to evaluate the significance of the % effective voids. The procedure developed by the Louisiana DOT was used to determine the % effective voids. The same method as the Rice Specific Gravity test was performed with the compacted specimen instead of the loose mix. The amount of voids that cannot be accessed by the water was computed, and then subtracted from the total voids to obtain the % effective voids. The researchers also developed this test by applying the full saturation to the specimen using the permeameter, and then determining the % effective voids after fully saturated. Figure 1 shows the relationship between % total voids and % effective voids in both LADOT method (before full saturation) and researcher's method (after full saturation). Figure 2 also shows the relationship between the permeability and % effective voids from both methods.



**Figure 1 % Effective Voids vs % Total Voids**



**Figure 2 Permeability vs % Effective Voids**

### 3. Development of the Experimental Design Matrix

A meeting of the research team was held on March 12 at the University of Wisconsin-Madison. During the meeting the following critical factors to be studied in the project were defined.

Aggregate Sources	Gravel (G), Limestone (L)
Gradations	Coarse (C), Fine (F)
Strength/Stiffness Base	Stiff (S), Weak (W)

NMAS	9.5 mm, 12.5 mm, 19 mm
Thickness	1 in, 2 in, 3 in
Air Voids	Low (4-6%), Medium (8%), High (10-12%)

Using these factors the experimental design matrix was developed as shown in Table 1 (also see attached document-Part 2). The blank cells in Table 1 will be filled based on statistical methods to reduce the number of combinations in the experiment.

The design indicates that a minimum of 8 projects, covering all variables (2 aggregate sources, 2 gradations, 2 bases) are required. It is expected that such projects will be identified for field study by summer 2002.

**Table 1 Experimental Design Matrix**

Project	#1	#2	#3	#4	#5	#6	#7	#8
Source	G	G	G	G	L	L	L	L
Gradation	C	C	F	F	C	C	F	F
Base	S	W	S	W	S	W	S	W
Thickness	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3
Air Voids, Low Medium High	To be determined							
NMAS, 19 12.5 9.5	To be determined							

#### 4. Work accomplished as related to the field study

- Based on recommendations from the WisDOT technical staff, a list of state projects that have already been accepted as the lowest bid for a mainline HMA projects was created by the research team. The list was created by using the highway bids and the three low bids from the WisDOT website.
- The field permeameter from the Wisconsin Department of Transportation is broken but will be fixed by early spring with enough time to be able to test and to get tarinng on the equipment.
- All four major contractors (Amon, Mathy, Payne & Dolan, Pitlik & Wick) were contacted to get their mix designs for all their state projects for this summer.
- The nuclear density gauge and safety classes for Mr. Anthony Stakston of the UW-Madison has been reserved and he will be taking the classes in late April.

#### Work Next Quarter:

- The literature review study (Task 1) will be completed by the beginning of May.
- Minimum of 8 projects, covering all variables (2 aggregate sources, 2 gradations, 2 bases) will be identified for field study next quarter. And at least one project will be strated in May 2002.
- Identifying of the HMA plants and aggregate sources (Task 2) will be done by May 2002.
- The meeting among the team members (UW-Madison, Marquette, and UW-Platteville) will be on Thursday, 4/25.
- The meeting with TOC will be held in late of May 2002.

#### Circumstances affecting progress/budget:

# Gantt Chart:

PROJECT I.D.0092-02-14	STARTING DATE	COMPLETION DATE	MONTH												Report#				
PROJECT # WISDOT	7-Nov -01	7-Nov -04	15-Apr												2				
CONSULTANT FIRM NAME		% TIME ELAPSED	TOTAL PROJECT FUNDING						CONTRACT FUNDING			PERCENT OF							
UW - MADISON									100%										
NAME OF STUDY															PROJEC T	TASK COMPLETE	TASK COMPLETE	PROJECT COMPLETE	
THE EFFECT OF PAVEMENT THICKNESS ON SUPERPAVE MIX PERMEABILITY AND DENSITY																			
TASK *	YEAR	2001	2002					2003				2004							
	MONTH	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 5	Qtr 6	Qtr 7	Qtr 8	Qtr 9	Qtr 10	Qtr 11	Qtr 12	Qtr 13					
TASK 1 : Review national and regional research on consistent aggregate sources															10		70	7	
TASK 2 : Identify commercial HMA plants with consistent aggregate sources															8		50	4	
TASK 3 : Identify project for field comparisons															8		0	0	
TASK 4 : Evaluation of effect of directional hydraulic conductivity															10		0	0	
TASK 5 : Conduct field and laboratory studies															25		0	0	
TASK 6 : Analyze data and prepare guidelines															25		0	0	
TASK 7 : Prepare and submit final report															10		0	0	
Final Report review and revisions															2		0	0	
Final Report Submittal															2		0	0	
Scheduled															100			11	
Completed																			

Note: Gantt chart shown in State Fiscal Year Quarters